

**Remarks/Arguments:**

The present invention relates to a hermetic compressor including grooves provided at an upper side and a lower side of the outer circumference of a piston. The shape of the grooves when developed in a plane is a curved shape to be gradually increased in sliding width toward the skirt direction of the piston so as not to form a parallel line to the axial center of the piston.

Claims 1-3 and 5-15 are currently pending in the application. With this Amendment, independent claims 1, 6, 11 and 12 have been amended. Claims 16-18 are new. No new matter has been added.

**Claim Rejections - 35 U.S.C. § 112**

Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite. Claim 2 has been appropriately amended. Withdrawal of the rejection is respectfully requested.

**Claim Rejections - 35 U.S.C § 103(a)**

Claims 1-3 and 6-15 are rejected under 35 U.S.C. § 103(a) as being unpatentable over JP 2003065236 (hereinafter "Katayama") in view of U.S. patent 2,407,440 (hereinafter "Osborne") further in view of U.S. Patent 5,076,226 (hereinafter "Watanabe"). Claim 5 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Katayama in view of Osborne further in view of Watanabe as applied to claim 1 further in view of U.S. Patent 5,092,747 (hereinafter "Irino"). It is respectfully submitted, however, that the claims are patentable over the art of record for the reasons set forth below.

Katayama is directed to a hermetic electric compressor wherein an annular lubrication groove 23e is recessingly formed on the outer periphery of the piston. Osborne, newly cited, is directed to a piston for internal-combustion engines including thrust relief recesses 9/9a located on each thrust side of the piston. Watanabe is directed to an internal combustion engine piston wherein recesses are formed in the skirt proximate to each thrust surface. Irino is directed to a fluid compressing apparatus having a refrigerant.

Applicants' invention, as recited by claim 1 includes a feature which is neither disclosed nor suggested by the art of record, namely:

... a **width** of the grooves being **greater** at an upper portion thereof ...

(Emphasis Added).

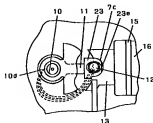
This feature describes the hermetic compressor including the grooves that have a wider width at an upper portion of the piston. The shape of the grooves in the hermetic compressor is a semicircular shape extending toward the skirt side of the piston. The curvature of the first outer shape of the first groove portion extending toward the skirt side of the piston is smaller than the curvature of the third outer shape of the second groove portion extending toward the upper portion of the piston leading to the width of the grooves being greater at an upper portion of the piston. This feature is found in Applicants' specification at paragraph [0074], lines 1-7, and FIG. 3. No new matter has been added.

Regarding independent claim 1, Katayama is relied upon, on page 3 of the Office Action, as disclosing all features of claim 1, except for "closed semicircular shaped grooves including further details of the grooves". The Examiner argues that Osborne teaches closed grooves 9 and the shape of the grooves 9 including a first, second and third outer shapes. The Examiner further argues that Watanabe teaches semicircular shaped grooves 28/328 and the combination of the grooves 9 in Osborne and the grooves 28/328 in Watanabe are equivalent to the grooves disclosed in Applicants' claim 1. Applicants respectfully disagree with the Examiner's assertion.

As shown below in FIGS. 3 and 5 of Katayama, **annular** lubrication grooves 23e are formed on the outer periphery of the piston 23a in parallel. Because the grooves 23e in Katayama are annular grooves, a width along the annularity cannot be defined in the annular groove. Katayama therefore **teaches away** from a **width** of the grooves being **greater** at an upper portion of the piston.

【図3】

7c 円筒状の軸リキネ  
23e 環状の給油溝



【図5】

23a ピストン  
23e 環状の給油溝

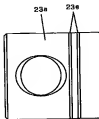
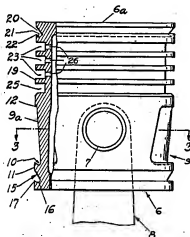
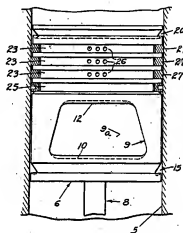


Fig. 1 and Fig. 2 of Osborne, reproduced below, show that each of relief recesses 9 tapers. As to the width of the recesses 9, the narrow portion of their taper is directed toward the upper end 6a of the piston 6" (Fig. 2), as described in col. 2, lines 19-22. Osborne provides the piston with the recesses 9 which are so positioned and contoured as to accelerate the movement of the oil across the surface to be lubricated when the engine is in operation (col. 1, lines 28-30). The contour of the recesses 9, which is tapered toward the upper end 6a, is required in Osborne. Osborne therefore **teach away** from a **width** of the grooves being **greater** at an upper portion of the piston.

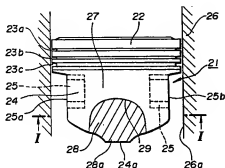


*Fig. 1.*

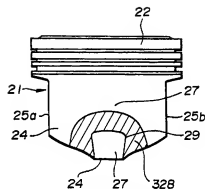


*Fig. 2.*

Below are FIG.1 and FIG.9 of Watanabe. Note that a curved "barrel-like" surface 29 of the recesses 28/328 is formed (col. 3, lines 10-29, and abstract). The width of the grooves 28 and 328 is narrow at the portion close to the top side 22 of the piston. The rounded surface 29 at the upper portion of the recess is **required** to eliminate the formation of sharp edges and permit oil to flow uninhibited out of the recess onto the thrust surfaces. In this manner, an adequate amount of lubricating oil is introduced between the thrust surfaces 27 and the bore wall 26a and prevents the oil film breakage. Thus, the rounded surface 29 is required in Watanabe in order to ensure an adequate supply of oil onto the thrust surfaces of a reciprocating type internal combustion engine piston. Watanabe therefore **teaches away** from a **width** of the grooves being **greater** at an upper portion of the piston.



**FIG. 1**



**FIG. 9**

Katayama in view of Osborne further in view of Watanabe is different from Applicants' claim 1, because as discussed above, Applicants' claim 1 requires a width of the grooves being greater at an upper portion thereof. This is different from Katayama because, Katayama **teaches away** from a **width** of the grooves being **greater** at an upper portion of the piston.

Furthermore, neither Osborne nor Watanabe overcomes the deficiencies in Katayama. As discussed above, both Osborne and Watanabe **teach away** from a **width** of the grooves being **greater** at an upper portion of the piston. Therefore, neither Osborne nor Watanabe makes up for the deficiencies discussed above with respect to Katayama.

Accordingly, Katayama in view of Osborne further in view of Watanabe fails to disclose, teach or suggest each and every feature in the Applicants' claim 1.

It is **because** Applicants include the feature of a width of the grooves being greater at an upper portion of the piston, that the following advantages are achieved. As described in Applicants' specification at paragraph [0018], by this configuration, high reliability, large refrigerating capacity and high efficiency are achieved by reduction of frictional loss through decrease of contact area.

Accordingly, for at least the reasons set forth above, claim 1 is patentable over the art of record. Claims 2, 3, 7, 8, 13 and 14 include all of the features of claim 1. Thus claims 2, 3, 7, 8, 13 and 14 are also patentable over the art of record for at least the reasons set forth above with respect to claim 1.

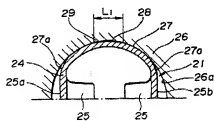
Independent claims 6, 11 and 12, while not identical to claim 1, include features similar to claim 1. Accordingly, claims 6, 11 and 12 are also patentable over the art of record for at least the reasons set forth above with respect to claim 1. Claims 9 and 10 include all of the features of claim 6. Thus, claims 9 and 10 are also patentable over the art of record for at least the reasons set forth above with respect to claim 1. Claim 15 includes all of the features of claim 11. Thus, claim 15 is also patentable over the art of record for at least the reasons set forth above with respect to claim 1.

The Official Action also cites to Irino for the rejection of dependent claim 5. The Official Action asserts that Irino teaches that hydrocarbon refrigerants are widely used in refrigerant compressors. Applicants' respectfully submit, however, that Irino does not overcome the deficiencies of Katayama discussed above with respect to claim 1. Any combination of Katayama, Osborne, Wantanabe and Irino therefore fails to disclose, teach or suggest each and every feature of Applicants' claim 1. Accordingly, claim 5, which includes all of the features of claim 1 from which it depends, are also patentable over the art of record for at least the reasons set forth above with respect to claim 1.

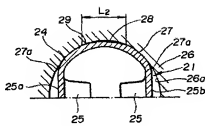
Applicants have added new dependent claims 16-18. Claims 16-18 include all of the features of allowable claims 1 and 6, respectively. Accordingly, claims 16-18 are also patentable over the art of record for at least the reasons set forth above with respect to claims 1 and 6, respectively.

Moreover, regarding independent claim 11, the Examiner maintains the argument from the last Office Action dated 01/13/2010 "... since the grooves [of] Watanabe et al are in a circular or semicircular fashion once modified the grooves will encompass (encircle) the through hole of Katayama." Applicants once again **disagree** with the Examiner's assertion.

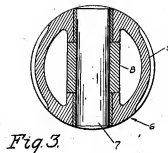
As shown below left and middle, in FIG. 4 and FIG. 5 of Watanabe, the grooves 28 and 328 are **purposefully** placed away from the through hole. Furthermore, as shown in Fig. 3 of Osborne, reproduced below right, these recesses are located at each thrust side of the piston and its pin 7, as described in col. 2, lines 13-15. Similarly, the recesses of Osborne are also **purposefully** placed away from the through hole. Accordingly, distinct from the reasons set forth above with respect to claim 1, Watanabe cannot properly be combined with Osborne and Katayama to reject claim 11.



**FIG. 4**



**FIG. 5**



*Fig. 3*

Regarding independent claim 12, the Examiner presents a similar argument on page 10 as that regarding claim 11 on page 9, "... since the grooves [of] Watanabe et al are in a circular or semicircular fashion once modified the grooves will encompass (encircle) the through hole of Katayama." The Examiner's argument regarding the through hole is **not correct**. In fact, the feature of the through hole is not included in claim 12. Instead, claim 12 includes "a sliding surface is provided all around a skirt side of the piston". The Examiner does not assert that this feature is disclosed in any of the cited references. Accordingly, the Office has not established a *prima facie* case of obviousness with respect to claim 12.

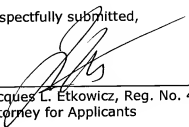
Finally, regarding dependent claim 10, the Examiner mischaracterizes the grooves 23e of Katayama. The Examiner argues that Katayama discloses "... grooves 23(e) are provided at an upper side and a lower side of the outer circumference of the piston, wherein a through-hole is disposed at about the center of the grooves (Figure 5)." The Examiner's argument about the grooves 23(e) is **not correct**, because the grooves 23(e) in Katayama are parallel annular grooves close to the top side of the piston and the through-hole in Katayama has no overlap with the grooves 23(e) (see Figure 5 of Katayama).

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Reply to Office Action of April 29, 2011

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In view of the amendments and arguments set forth above, Applicants submit that the above-identified application is in condition for allowance which action is respectfully requested.

Respectfully submitted,



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